

# **The Science of Life**

# Themes of Biology

## The Study of Life

- The first life form arose on Earth ~3.5 billion years ago



# Themes of Biology

## The Study of Life

- Evidence suggests that the first *organism* was unicellular and would have been unable to be seen without the help of a microscope.
- Organism- living thing



# Themes of Biology

## The Study of Life

- All of the organisms found on Earth today are distant relatives of this first organism
- The numerous differences between all of the organisms today are due to changes and adaptations required for survival

# Themes of Biology

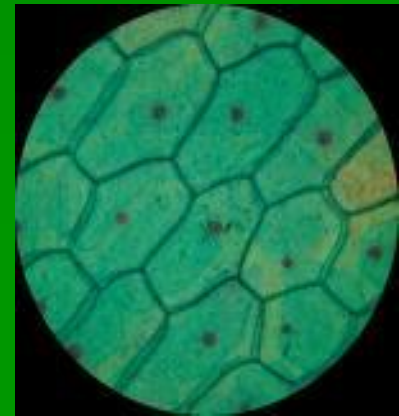
## The Study of Life

- *Biology* is the study of the life and of these millions of diverse organisms
- Biology has six unifying themes:
  - Cell structure and Function
  - Stability and Homeostasis
  - Reproduction and Inheritance
  - Evolution
  - Interdependence of Organisms
  - Matter, Energy and Organization

# Themes of Biology

## Cell Structure and Function

- The cell is the smallest subdivision of life.
- Unicellular vs. Multicellular
  - Unicellular – Single Cell
  - Multicellular – Multiple Cells

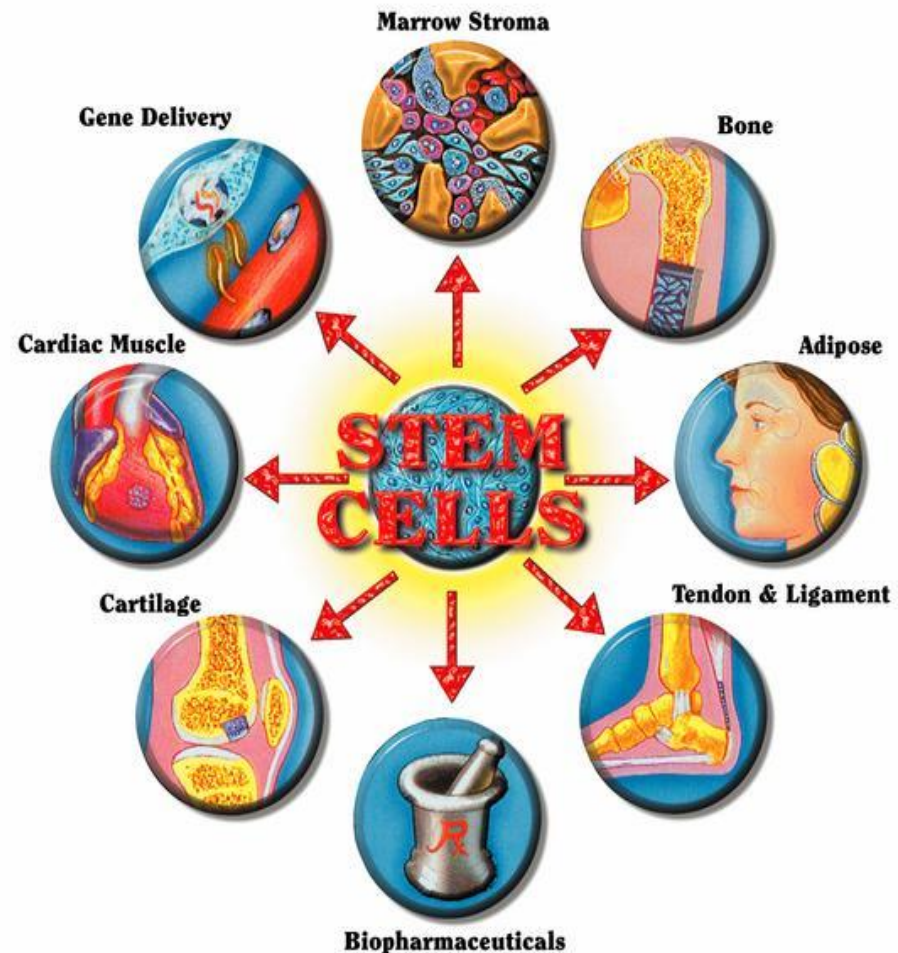




# Themes of Biology

## Cell Structure and Function (cont)

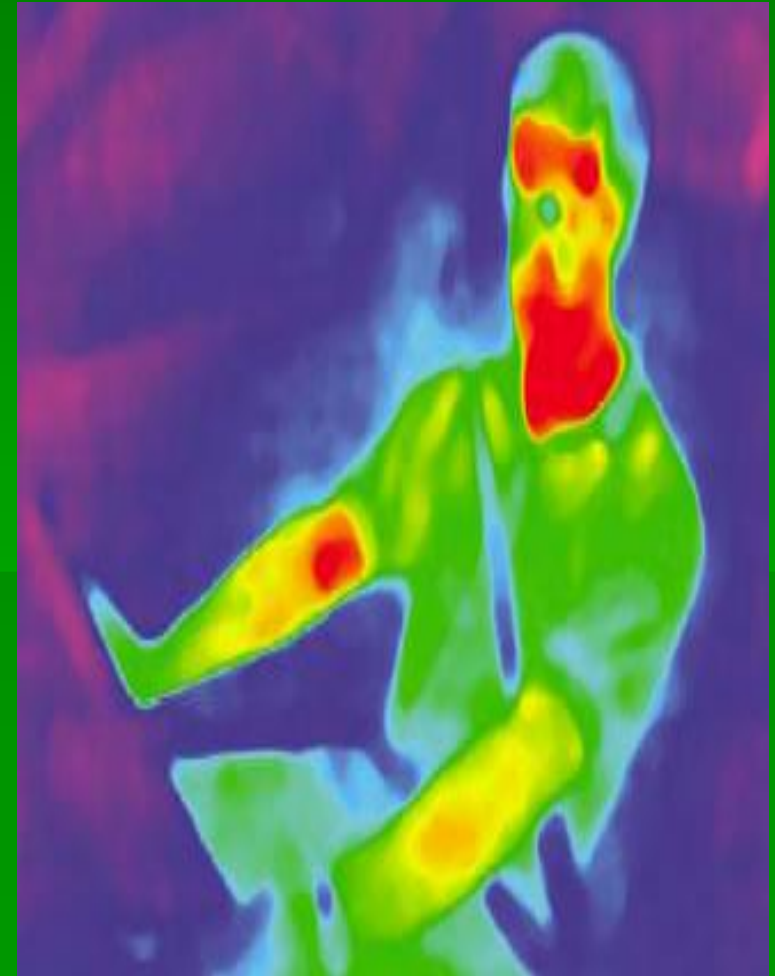
- Cells are highly organized and specialized structures that are the base for all of you
- The cells of multicellular organisms undergo *differentiation* early in their existence.
  - Differentiation- specialization, depending on the cells final role in the organism



# Themes of Biology

## Stability and Homeostasis

- The delicate balance of life is maintained by the process of *homeostasis*.
  - Homeostasis – stable levels of internal conditions





# Themes of Biology

## Reproduction and Inheritance

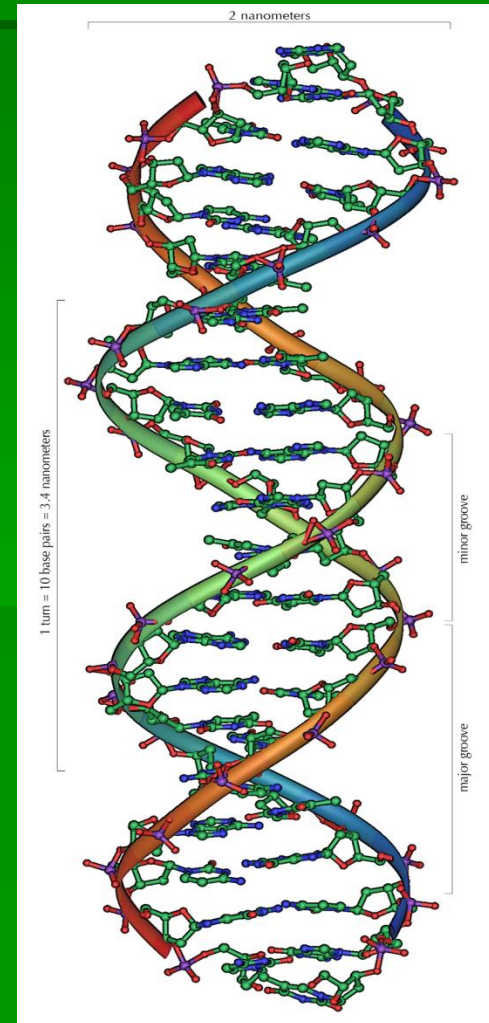
- All organisms produce new organisms like themselves, this process is called *reproduction*.
  - Reproduction – transmission of hereditary information to offspring

2 Types: Sexual and Asexual

# Themes of Biology

## Reproduction and Inheritance (cont)

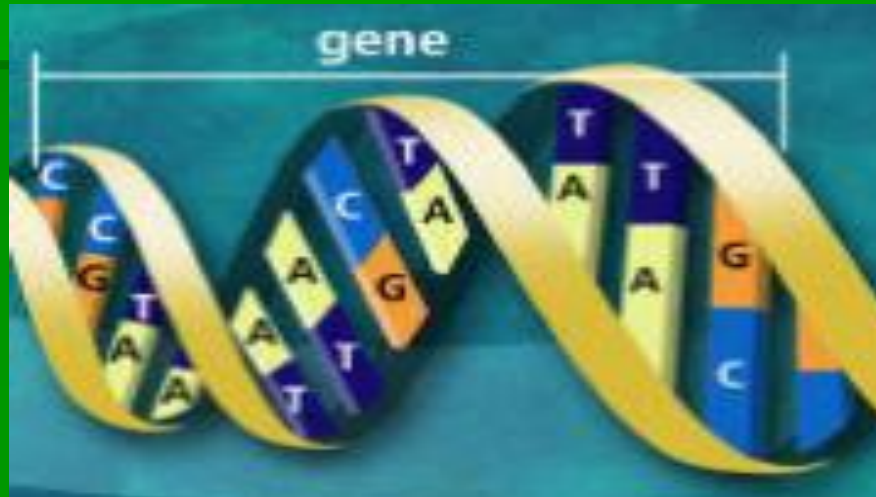
- The hereditary information mentioned before takes the form of *DNA*.
  - DNA – deoxyribonucleic acid



# Themes of Biology

## Reproduction and Inheritance (cont)

- The information held on the DNA is found in short segments called *genes*.
  - Genes – a unit of hereditary information



# Themes of Biology

## Reproduction and Inheritance (cont)

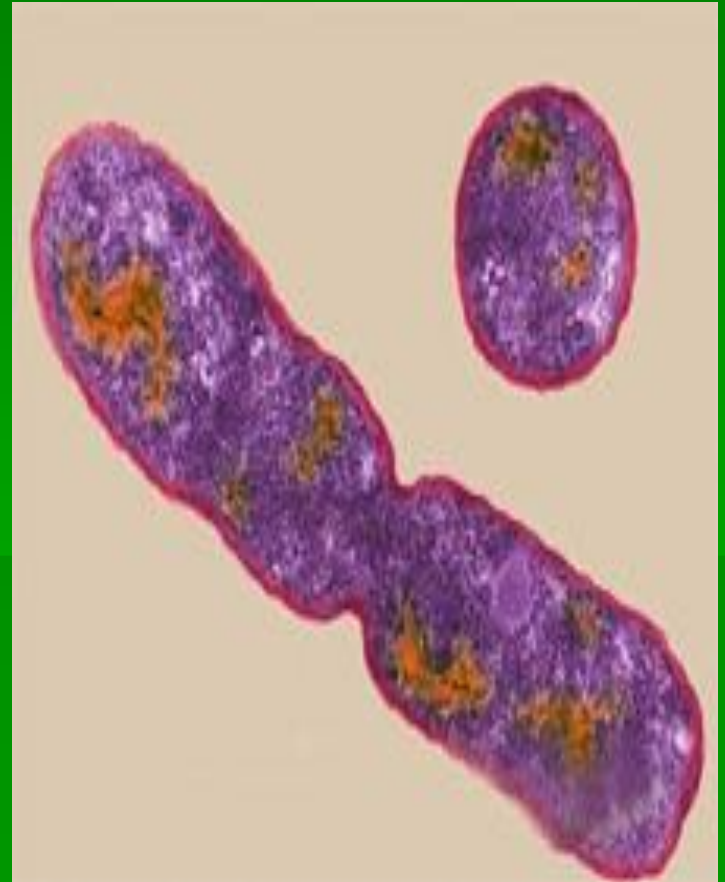
- *Sexual Reproduction* is hereditary information from two parts of a single organism or from two separate organisms combined to form a new organism
  - Sexual Reproduction – the passing on of hereditary information to an offspring from two separate hereditary sources



# Themes of Biology

## Reproduction and Inheritance (cont)

- *Asexual Reproduction* is the formation of offspring with the input of only one hereditary source
  - Asexual Reproduction - The production of offspring that does not involve the union of gametes

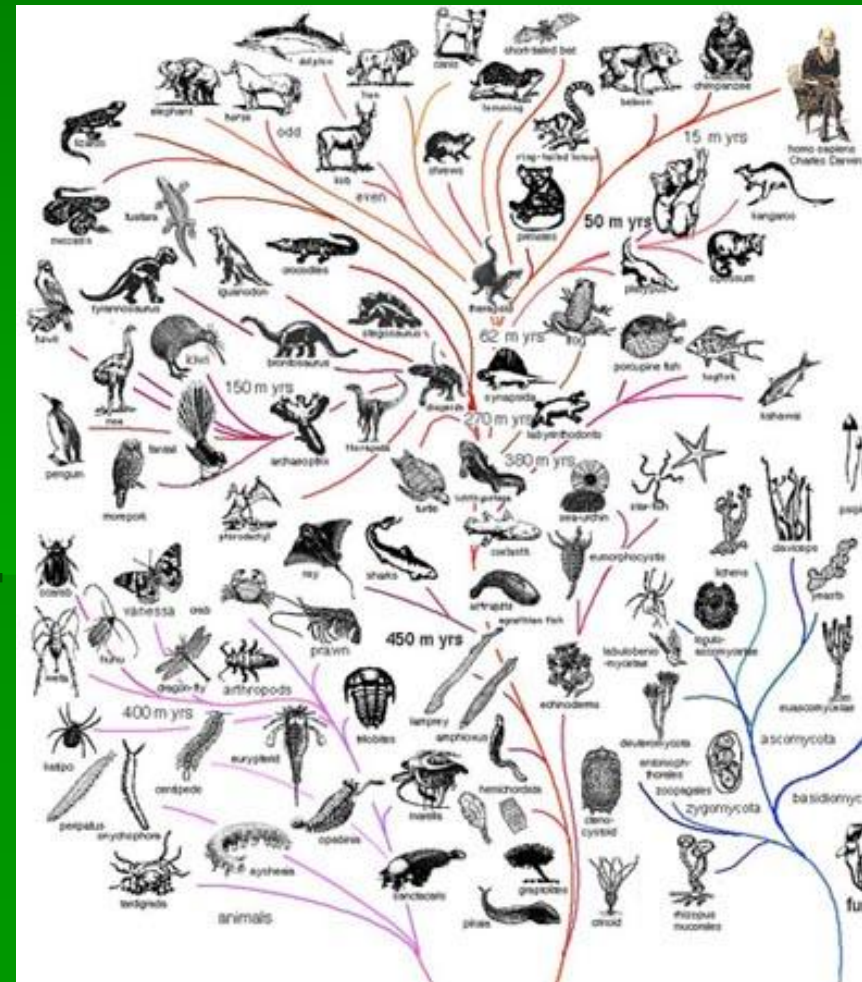




# Themes of Biology

## Evolution

- Organisms that exist on Earth today are very different from those found millions of years ago do to *evolution*.
  - Evolution – is the change of populations to adapt to the changing environment

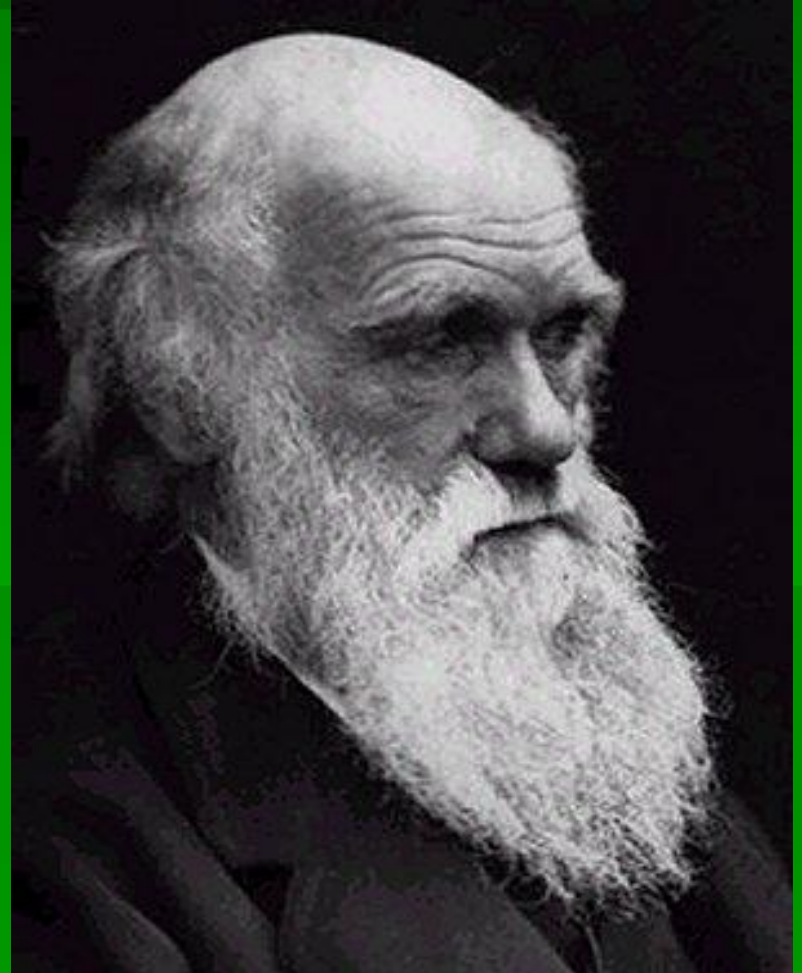




# Themes of Biology

## Evolution

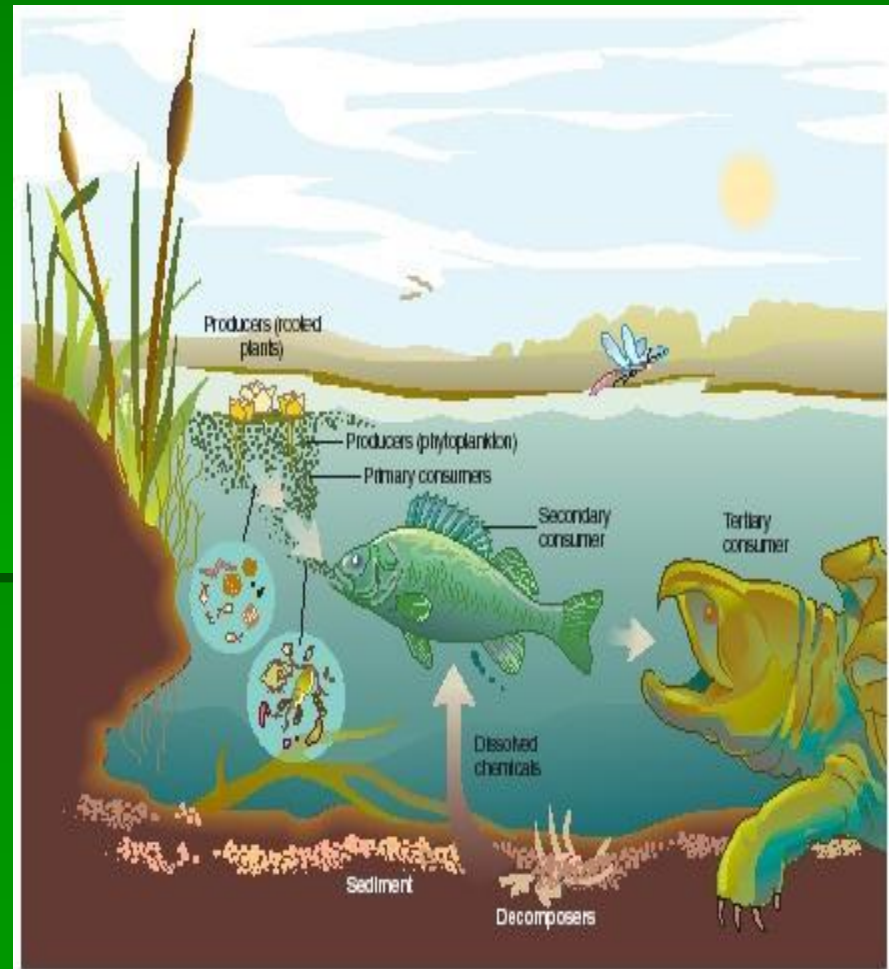
- *Natural Selection* is the most important driving force of evolution.
  - Natural Selection – “survival of the fittest”



# Themes of Biology

## Interdependence of Organisms

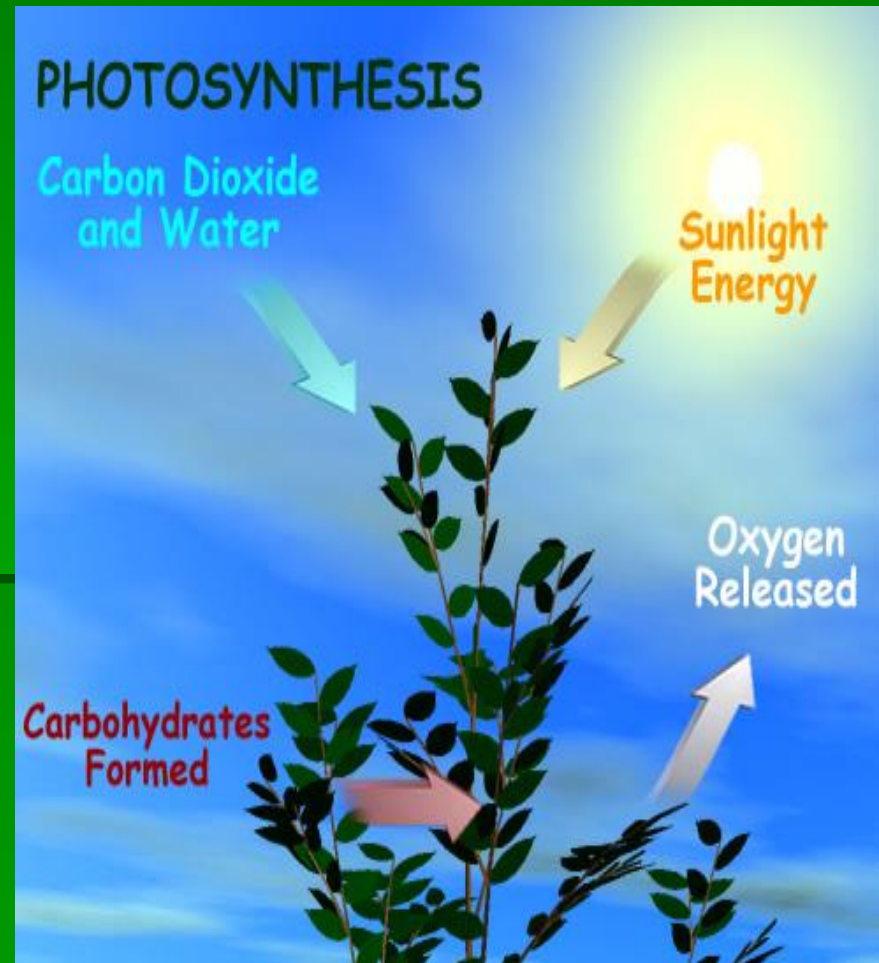
- The interactions of organisms and their environment is known as the study of ecology.
- Scientists can specialize their studies to organisms or the can study the *ecosystem*.
  - Ecosystem – environmental communities including all organisms that live there



# Themes of Biology

## Matter, Energy and Organization

- Organisms must constantly be provided with energy, almost all energy used by organisms on Earth is provided by *photosynthesis*.
  - Photosynthesis – the conversion of solar energy to food energy



# Themes of Biology

## Matter, Energy and Organization (cont)

- There are 2 types of consumers:
  - 1.) Autotrophs – produce their own food from solar or chemical sources
  - 2.) Heterotrophs – consume other organisms to meet their energy requirements

# The World of Biology

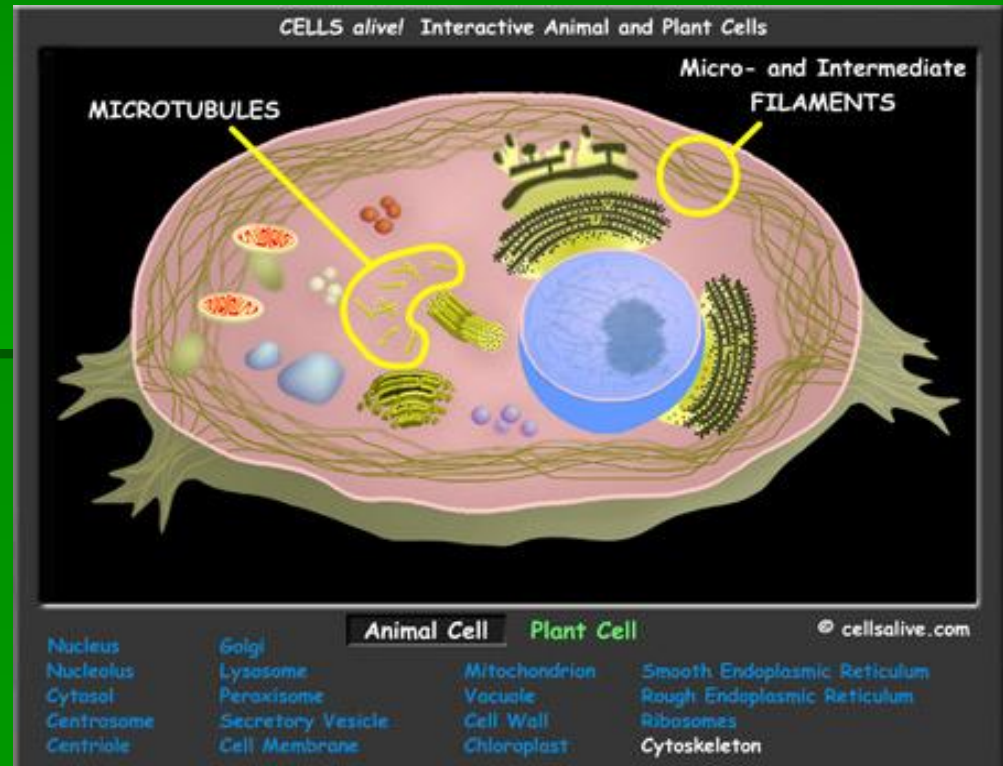
## Characteristics of Life

- 1.) Cells
- 2.) Organization
- 3.) Energy Use
- 4.) Homeostasis
- 5.) Growth
- 6.) Reproduction

# The World of Biology

## Cells

- All living things are made up of cells.

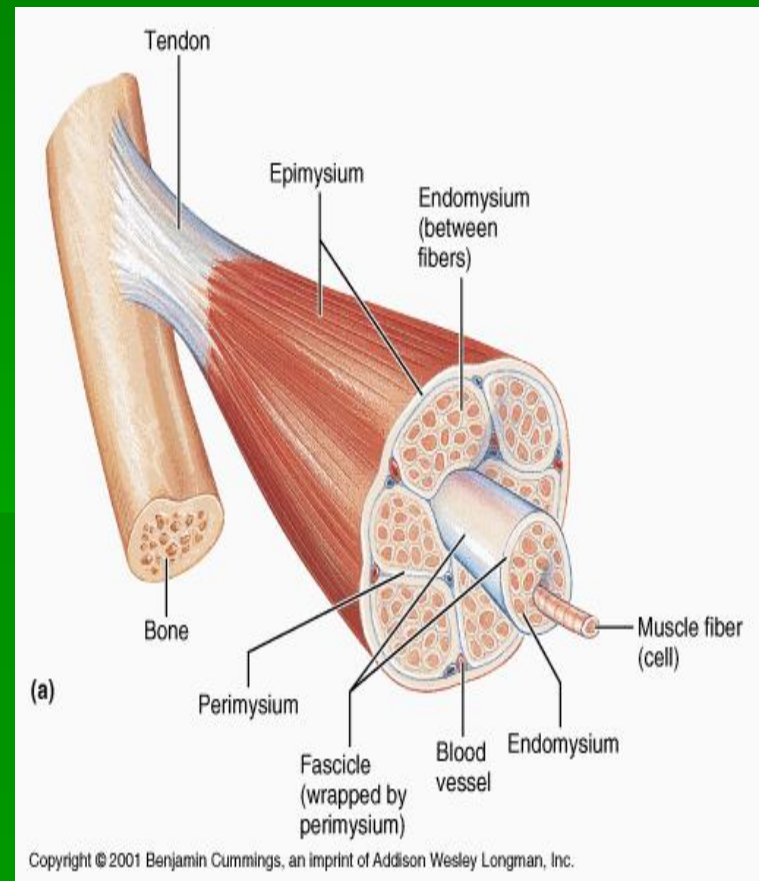




# The World of Biology

## Organization

- All living things are highly organized and can reorganize materials they take in.



# The World of Biology

## Energy Use

- All living things use energy in a process called metabolism.



# The World of Biology

## Homeostasis

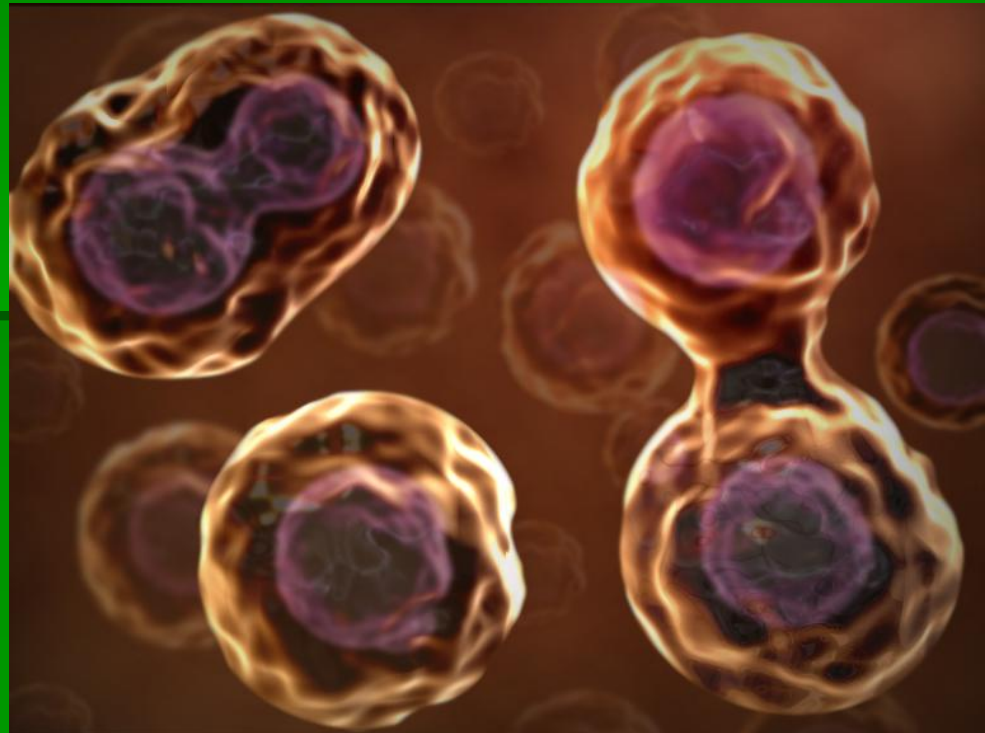
- All living things maintain stable internal conditions.



# The World of Biology

## Growth

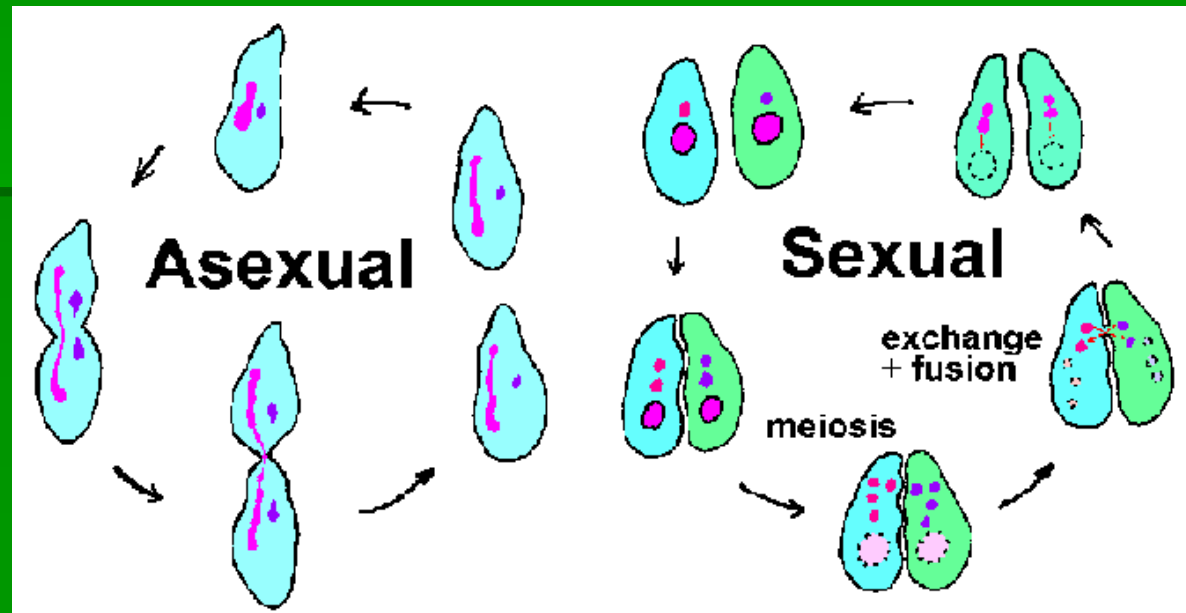
- All living things grow in a process called cell division.



# The World of Biology

## Reproduction

- All living things reproduce to help their population survive.



# Scientific Methods

## Asking a Question

- All scientific investigations begin with one or more questions.





# Scientific Methods

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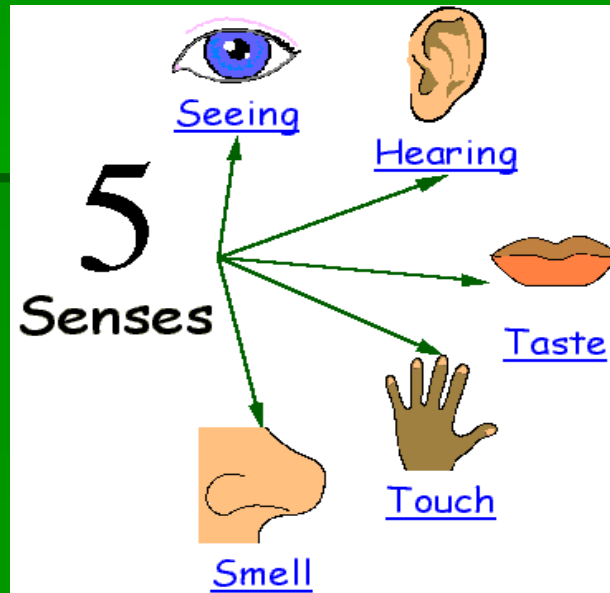
## Collecting Data

- **Data** include any and all information that scientists gather in trying to answer their questions.
- 2 types:
  - 1.) Quantitative or Numerical
  - 2.) Qualitative or Observational

# Scientific Methods

## Observing

- **Observation** usually employs one or more of the five senses to perceive an object.



# Scientific Methods

## Measuring

- Measurements are record of your observations.



# Scientific Methods

## Sampling

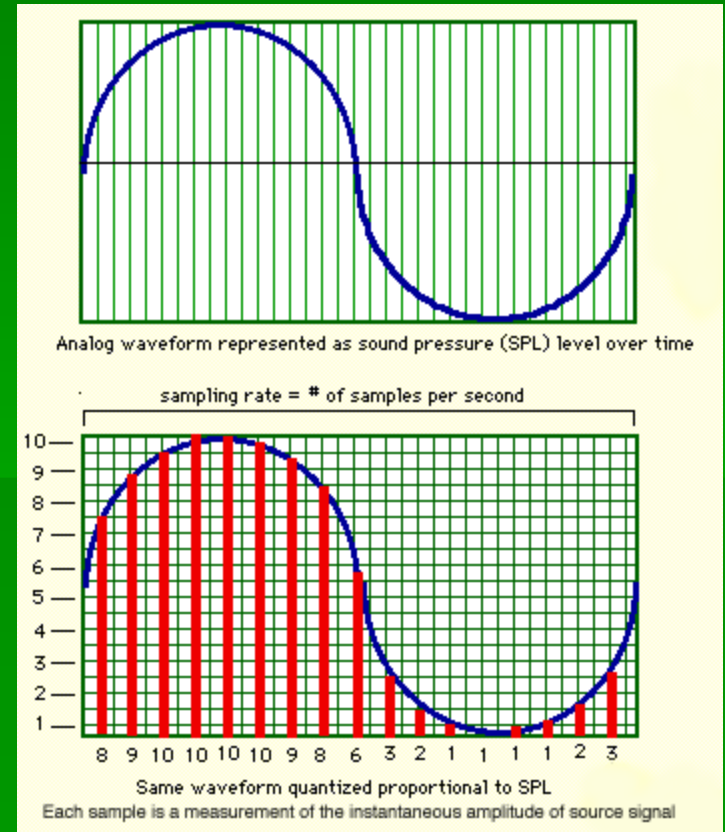
- Scientific **sampling** is the technique of using a small part of a population to represent the entire population.



# Scientific Methods

## Organizing Data

- **Organizing Data** involves placing observations and measurements in some kind of logical order, such as a chart or a graph or a table.



# Scientific Methods

## Hypothesizing

- A **hypothesis** is a statement that explains their observations *and* can be tested.





# Scientific Methods

## Predicting

- A **prediction** is a statement made in advance that states the results that will be obtained from testing a hypothesis.

# Scientific Methods

## Experimenting

- An **experiment** is the testing that is done to prove or disprove a hypothesis.



# Scientific Methods

## Conducting a Controlled Experiment

- A **controlled experiment** is based on the comparison of a **control group** with an **experimental group**.

# Scientific Methods

## Conducting a Controlled Experiment

- The **independent variable** is the only factor that differs between the two experiments.

# Scientific Methods

## Conducting a Controlled Experiment

- The **dependent variable** is the factor in both the control and experimental groups that is measured and compared.

# Scientific Methods

## Analyzing Data

- **Analyzing data** is the process of determining whether data are reliable and whether or not they support the hypothesis.





# Scientific Methods

## Drawing a Conclusion

- After analyzing the data the next step is to **draw a conclusion.**



# Scientific Methods

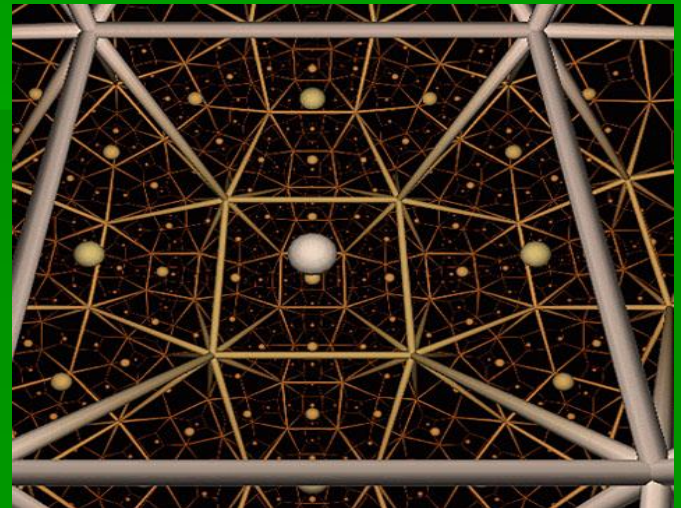
## Inferring

- An **inference** is a conclusion made on the basis of facts or premises rather than on direct observations.

# Scientific Methods

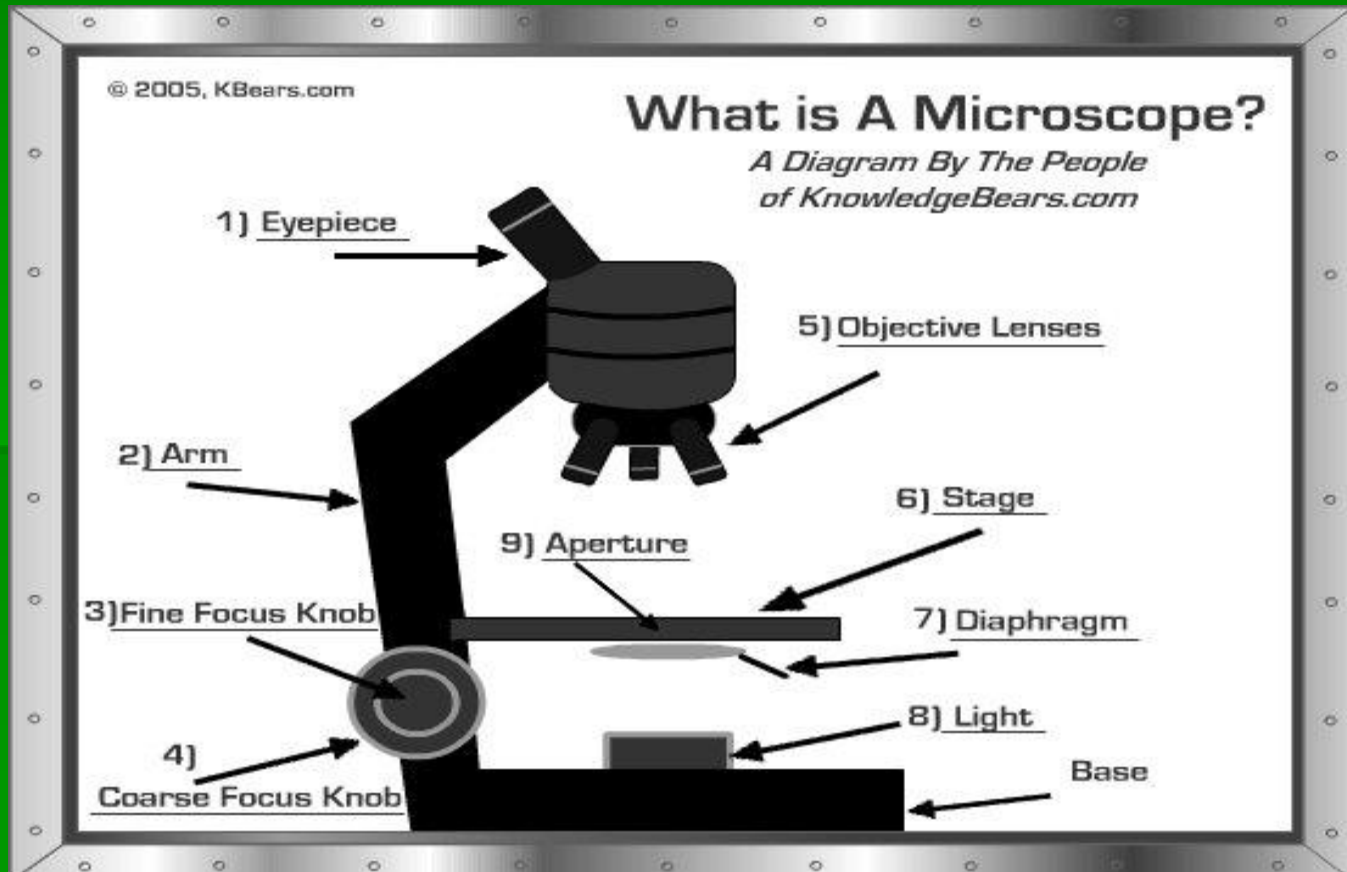
## Forming a Theory

- A **theory** is the broad and comprehensive statement that is thought to be true due to similar results from many rounds of testing.



# Microscopy and Measurement

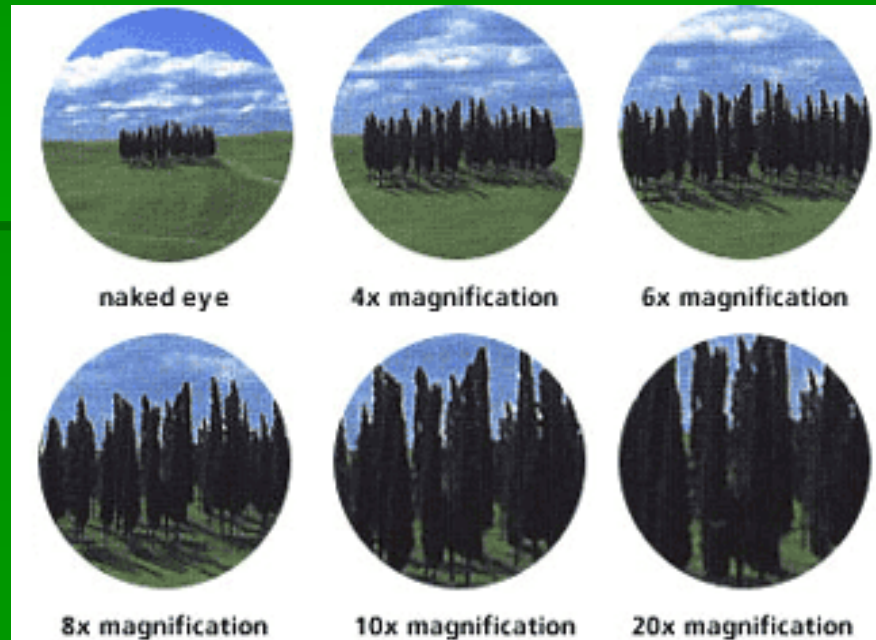
## Microscopes



# Microscopy and Measurement

## Microscopes

- The **magnification** is used to increase the perceived size of the object.



# Microscopy and Measurement

## Microscopes

- The **resolution** refers to the microscopes ability to show details clearly.





# Microscopy and Measurement

## Light Microscope

- To see small organisms and cells scientists use **compound light microscopes**.



# Microscopy and Measurement

## Electron Microscopes

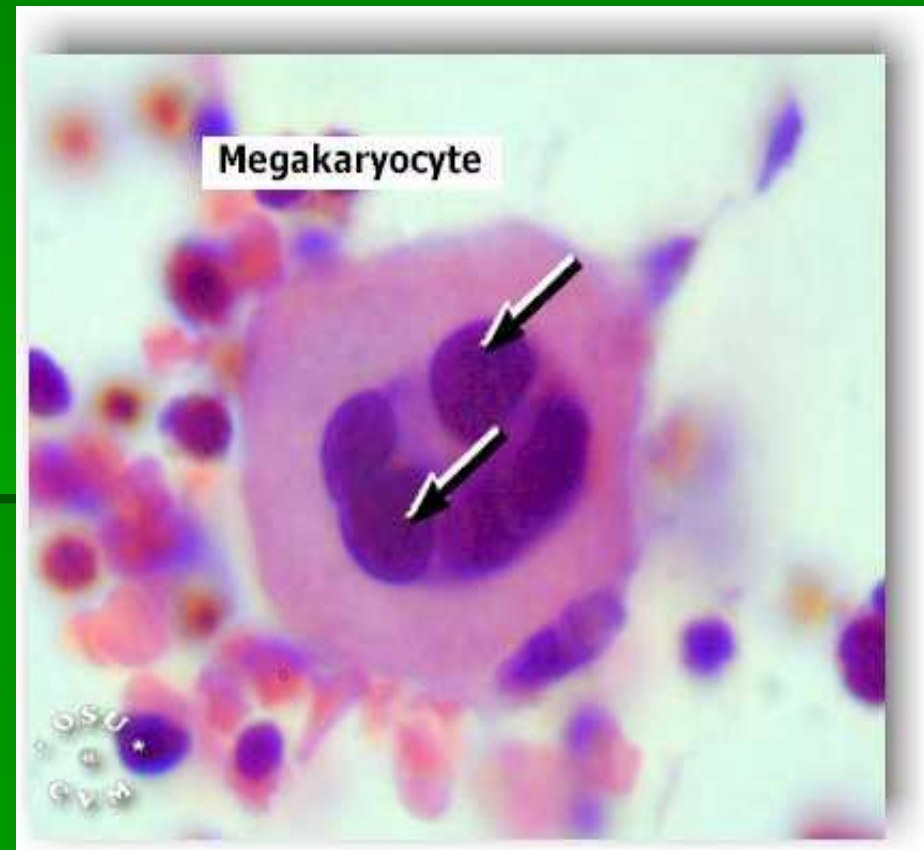
- In an **electron microscope** a beam of electrons is used to show an enlarged image.



# Microscopy and Measurement

## Electron Microscope

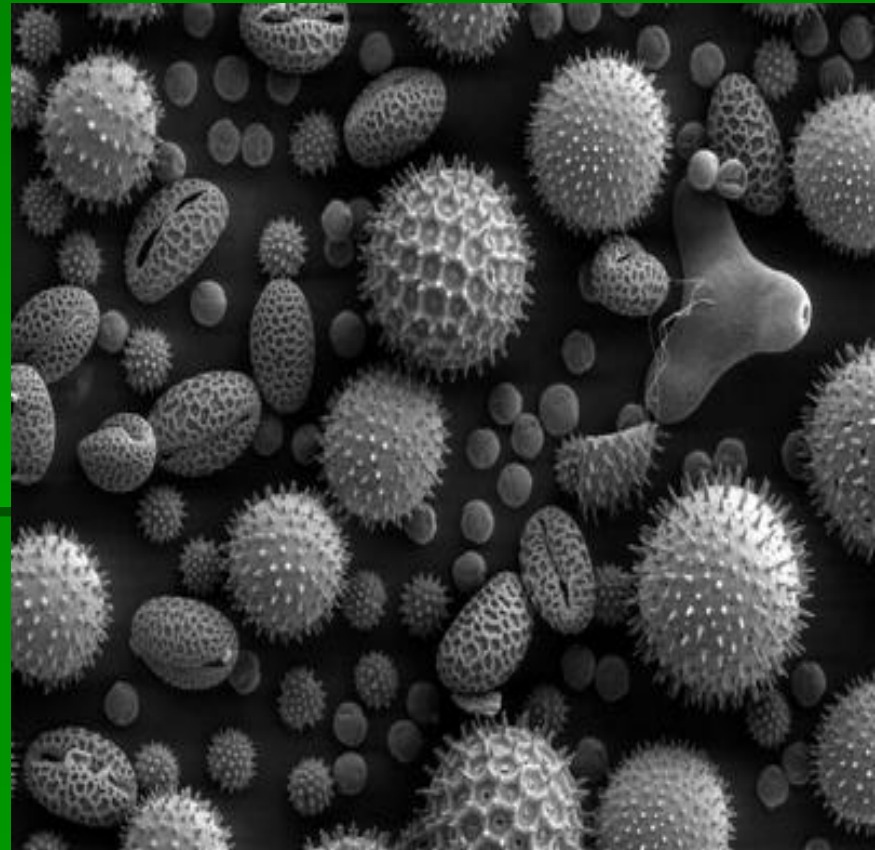
- The transmission electron microscope transmits a beam of electrons through a thinly sliced specimen.



# Microscopy and Measurement

## Electron Microscope

- The scanning electron microscope provides striking three dimensional images by using the same idea as the last microscope but on an intact specimen.



# Microscopy and Measurement

## Measurement

- The base unit for length is the **meter (m)**, the base unit for mass is the **kilogram (kg)**, the base unit for temperature is the **kelvin (k)** and the base unit for amount of a substance is the **mole (mol)**.

# Microscopy and Measurement

## Measurement

\* The metric conversion ladder:

kilo 1000

hecto 100

deca 10

base meter, gram, or liter

deci .1

centi .01

milli .001

\*To convert from one metric unit to another: